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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/461,756	12/16/1999	HIROYUKI KANO	9438-0014-2	4231

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EXAMINER

BAUMEISTER, BRADLEY W

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 01/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.
09/461,756

Applicant(s)
Kano

Examiner
B. William Baumeister

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Nov 1, 2002
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 5-32 is/are pending in the application.
- 4a) Of the above, claim(s) 5, 6, 9, 12, 19, and 22-31 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 7, 8, 10, 11, 13-18, 20, 21, and 32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____ 6) ☐ Other:

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DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claim 32 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Newly added claim 32 sets forth the further limitation that $E \leq V/9$. Applicant asserts that support for this limitation can be found in the specification at page 7, lines 1-2. (See REMARKS, page 3 of paper # 19.) However, this portion of the specification discusses increased carrier reflection that results from superlattices that are set to be odd quarter multiples of the wavelength of interest. This portion of the specification does not--nor does any other portion--discuss a transmission superlattice wherein the barrier and well thicknesses are set to be even quarter multiples so as to satisfy the newly claimed condition of $E \leq V/9$. As such, this limitation constitutes new matter.

3. Claims 8, 10, 11, 14-16, 18, 20 and 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject

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matter which applicant regards as the invention. These claims ultimately depend from claim 3 which has been canceled by the latest amendment. As such, it is unclear what the scope of these claims is intended to be.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Insofar as definite, claims 1, 7, 8, 10 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Capasso '009. Capasso teaches a light detecting device wherein a $n\lambda/2$ well 11 is sandwiched between $m_{\text{odd}}\lambda/4$ barrier/well superlattice regions 12 for producing carrier localization above the barrier (see e.g. FIG 2 and E6 of Fig 3). Just as explained in the previous rejections, while the reference does not disclose that superlattices are set to be even multiples of a desired wavelength, upon appropriate bias to some higher energy, E' such that $E' \simeq 4E$, the superlattice will inherently satisfy the $\lambda(E')/2$ transmission conditions claimed. Likewise, in regard to claims 10 and 11, as the generic expression, $n\lambda/2$, for the well 11 includes the specific situation of $n=1$ (i.e., $\lambda/2$), when the dimension is set according to this particular situation, the thickness of well 11 will necessarily satisfy the condition of being equal to this higher wavelength, $\lambda(E')$.

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Claim Rejections - 35 USC § 103

6. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

7. Claims 17, 18, 20 and 21 rejected under 35 U.S.C. 103(a) as being unpatentable over Capasso '009 as applied to the claims above. Capasso discloses that this invention may be employed for a variety of photodetectors (col. 1, lines 5-35), but does not expressly state that it may be employed in a p-i-n photodetector. Rather, Capasso only sets forth limited examples wherein the $\lambda/4$ -- $\lambda/2$ -- $\lambda/4$ wave interference structure is employed with two n-doped ohmic contacts (in the i-region of an n-i-n device). Nonetheless, p-i-n photodiodes were well known to those of ordinary skill in the art at the time of the invention, and it would have been obvious to have employed the Capasso wave interference structure in a p-i-n diode for the purpose of obtaining greater carrier localization in those p-i-n diodes as well, as taught by Capasso.

8. Insofar as definite, claims 1, 7, 8, 17, 18, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuji et al. '068 in view of Takagi et al., "Design of Multi-Quantum Barrier (MQB) and Experimental Verification of MQB Effect." Tsuji discloses p-I-n light-receiving or photoelectric devices wherein a series of superlattice structures are separated by well layers (carrier accumulation layers) which are composed of the same material (having the same band gap) as the wells of the superlattice (see e.g., FIGs 10-12, col. 3, line 30 and col. 8, lines 14-25). The barrier and wells layers of the superlattice regions are dimensioned so as to cause

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reflection above the conventional or expected conduction energy band level, creating a virtual barrier thereabove. Tsuji makes reference to earlier works of Capasso (e.g., col. 2, lines 1-) but does not expressly set forth the theory or calculations employed to set the thicknesses of the wells and barriers so as to produce this virtual barrier in the superlattice regions.

a. Takagi teaches that a virtual barrier above the expected energy level of the barrier's conduction band may be produced by setting the thicknesses of the superlattices' barriers and wells to odd multiples of a quarter-wavelength of carriers that are to traverse the superlattice. The equations for setting these thicknesses are exactly the same as the equation set forth in claim 3 except that Takagi teaches odd-multiples instead of even multiples as set forth in the present claims ($n = \text{even integer}$). (Mathematical calculations showing the relationship in terms of the layers' thicknesses have previously been included in other of Applicant's applications, including US Pat #6,188,083.) It would have been obvious to one of ordinary skill in the art at the time of the invention to set the superlattice barrier and well layers of Tsuji to odd multiples of a desired carrier wavelength according to Takagi for the purpose of improving the carrier reflectivity above the barrier conduction at these wavelengths as taught by Tsuji and Takagi.

b. The preceding explains why motivation exists to combine the references based on producing thicknesses that are odd multiples of a quarter wavelength of an energy, but does not address the limitation of the present claims that the thicknesses be even multiples. Nonetheless, once the teachings of these references are combined in the manner and for the reasons set forth above, the resultant structure will inherently satisfy all of the limitations of the stated claims,

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including the limitation that the thicknesses be even multiples of a carrier wavelength. This is because the wavelength of carriers traversing the superlattices and adjacent structures is a function of the applied energy. The carrier's energy, in turn, is a function of the voltage or bias applied across the device. Thus, for a device specifically designed to reflect a given energy E (superlattice is based on odd multiples), there inherently and necessarily exists some higher energy E' such that $\lambda_{E'} = \lambda_E/2$. Restated, when the thicknesses of the barriers and wells of this superlattice are designed so as to be odd multiples of the wavelength associated with energy, E , the thicknesses will be even multiples of this other energy E' .

The Examiner notes that a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See, e.g., *In re Pearson*, 181 USPQ 641 (CCPA); *In re Minks*, 169 USPQ 120 (Bd Appeals); *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). The language of this claim, as presented, does not distinguish the present invention over the combination of Tsuji and Takagi which possesses the same structure, as claimed.

9. Insofar as definite, claims 13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Capasso or alternatively Tsuji/Takagi as applied to the claims above, respectively, and further in view of Motoda et al. '350. Neither Capasso nor Tsuji/Takagi teaches all of the

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limitations of the claims as explained above except for the further inclusion of delta layers at the interface of the superlattices' barriers and wells. Motoda teaches that delta layers may be employed at the interfaces of a superlattice's barriers and wells for the purpose of more sharply varying the energy band profile at this interface. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to employ delta layers in the superlattice regions taught by Tsuji/Takagi for the purpose of more sharply varying the energy band profile, as taught by Motoda thereby further improving the desired reflection/transmission characteristic for which the superlattice is designed.

Response to Arguments

10. Applicant's arguments filed 11/1/2002 have been fully considered but they are not persuasive.

a. Applicant again argues that an odd-multiple quarterwave reflection superlattice (as disclosed by the prior art) will not inherently satisfy the even-multiple quarterwave equations of the present claims so as to produce increased transmission at some higher energy. The examiner disagrees for the reasons set forth previously. Also, please note that Figure 3 of Takagi supports the examiner's position by clearly depicting that the reflection MQB oscillates between high reflectivity and low reflectivity--including various points of zero or near-zero reflectivity--as the electron energy increases.

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INFORMATION ON HOW TO CONTACT THE USPTO

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister**, at (703) 306-9165. The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

A handwritten signature in black ink, appearing to read 'B. William Baumeister', written over a horizontal line.

B. William Baumeister

January 3, 2003